

FRAMERATES

1900 and onwards

But not even Griffith was consistent. His instructions for *Home Sweet Home* (1914) recommended 16 minutes for the first reel (16.6 fps), 14-15 minutes for the second (17.8-19 fps), and 13-14 for each of the other reels (19-20.5 fps).

'The last reel, however, should be run slowly from the beginning of the allegorical part to the end' (*Moving Picture World*, 20 June 1914 p. 652). 'The projectionist,' said Griffith, 'in a large measure is compelled to redirect the photoplay.'

On a technical level there were steady improvements on the existing technology but in essence the cameras stayed the same.

Although the 1888 [Roundhay Garden Scene](#) was shot at a groundbreaking 20 frames per second (fps), most cinematic films were shot at between 12,5 and 16 frames per second.



Film sizes

There were also a lot of different film sizes. But right from the beginning (the first cinematographic screening for a paying audience in 1895 by the brothers Lumiere used 35mm) 35mm became an important standard.

This was probably because the Eastman developed photographic film was 70mm wide.

But ever since there have been other standards around.

<http://www.film-center.com/formats.html>



Sound

In 1914 “The Photo Drama of Creation” was the first film to use pre-recorded sound at the screening (using a separate device).

Sound recording film was invented in 1918 in Hungary.

During late 1927, Warners released [The Jazz Singer](#), which was mostly silent but contained what is generally regarded as the first synchronized dialogue (and singing) in a feature film.

24fps

The introduction of sound (in the 1920's) made it important to standardize on film recording and projection framerates. The standard became 24 frames per second.

Even though Edison proclaimed 46 fps as the best framerate for motion pictures there are no remaining samples of films that were shot at that speed on his cameras.

Comparison of probable camera speeds (as indicated by Polygon)
and projection speeds (as specified by cue sheets)

					Camera fps	Projector fps
Blind Husbands		1919	16	?		
Foolish Wives			1921	16	18	
The Four Horsemen of the Apocalypse	1921	20	21			
Monsieur Beaucaire		1924	18	24*		
Robin Hood			1922	19	22	
Scaramouche	1923	19	22			
Merry Widow		1925	19	24		
Ben-Hur			1925	19	22	
The Crowd			1928	20	24	
Show People		1928	20	24		
Flesh and the Devil		1926	20	23		
Mysterious Lady		1928	20	24		
The Black Pirate		1926	20	24		
Lilac Time			1928	20	24	
Love			1927	20	24	
The Eagle			1925	22	24	
Wedding March			1928	22	24	
The Strong Man			1926	22	24	I
What Price Glory?			1926	22	24	
Trail of 98			1928	22	24	
Woman of Affairs		1928	24	24		
The General			1926	24	24	
Docks of New York		1928	24	24		
Queen Kelly			1928	24	24	

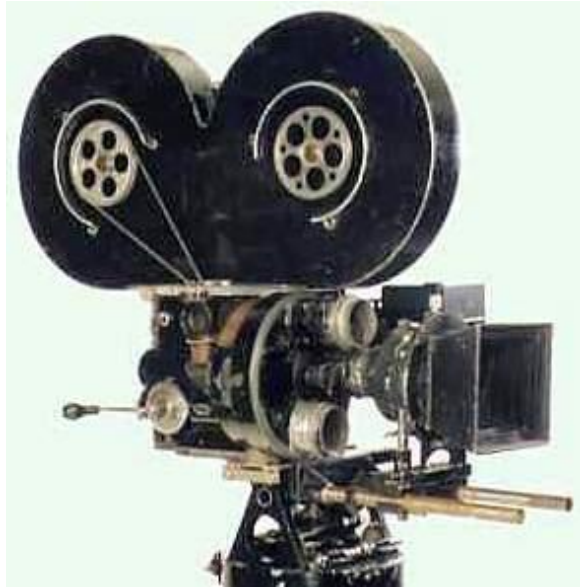
* Cue sheet specifies 'Do not run at normal speed of 85 feet per minute, but 90 as we feel the film requires it'

Framerate vs. refresh rate

When motion picture film was developed, it was observed that the movie screen had to be illuminated at a high rate to prevent visible flicker.

The exact rate necessary varies by brightness, with 40 Hz being acceptable in dimly lit rooms, while up to 80 Hz may be necessary for bright displays that extend into peripheral vision. The film solution was to project each frame of film three times using a three-bladed shutter: a movie shot at 16 frames per second would thus illuminate the screen 48 times per second. Later, when sound film became available, the higher projection speed of 24 frames per second enabled a two bladed shutter to be used maintaining the 48 times per second illumination — but only in projectors that were incapable of projecting at the lower speed.

Bell & Howell 1912



Arri 435 (1995)



Panavision (1985)





Television

In 1870 the 'concept of television' was first sketched in science fiction writings.

In 1930 television became commercially available.

To avoid interference problems with lighting equipment the framerate was tied to the frequency of the AC grid.

(60Hz in the US, 50Hz in Europe).

Interlacing

To avoid flickering the image would have to be projected at 60 fps, and the maximum amount of lines scanned would be around 200.











PAL, NTSC and SECAM

50i is the standard for PAL and SECAM television.

60i (or actually 59.94i...) is the standard for NTSC.

Film to television



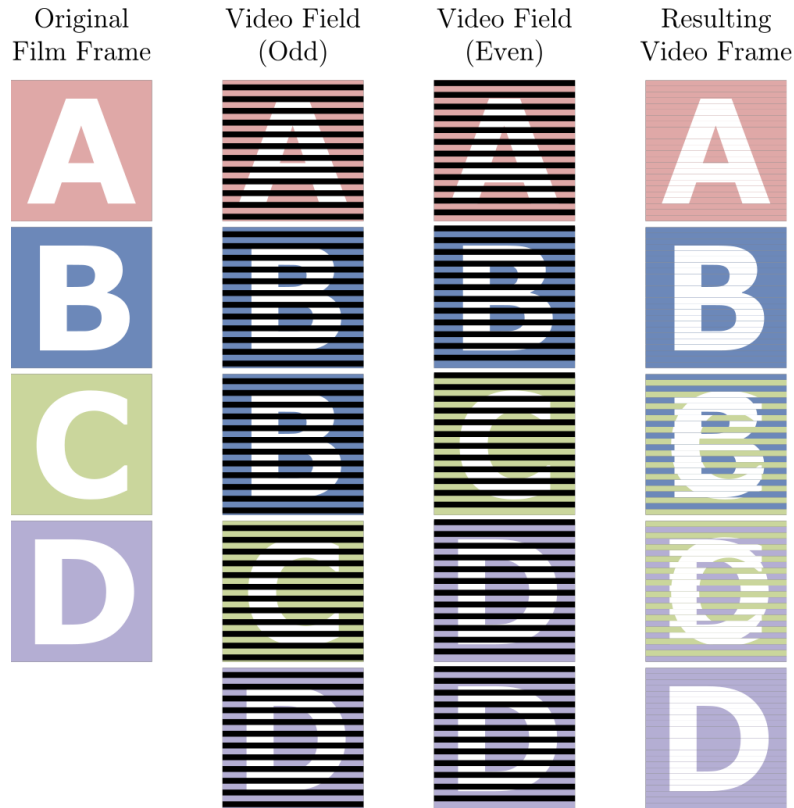
When film is transferred to video (for display on television, there were several options:

If the material was meant for television, the camera was set to match the TV framerate (25 or 30 fps (actually 29,97 fps).

To convert 24 frames to television there were two options:

For PAL the film was sped up to 25 fps (thus resulting in a shorter film).

3:2 pulldown



For NTSC it was no option to increase framerate of the original 24 fps material to 30 fps.

To convert 24 fps to 30 fps 4 frames are spread over 10 fields...

Digital video

PAL and NTSC have been the standards for more than 50 years – and although many parts of the image chain have improved over time the core specification stayed the same.

Analog high-definition never really caught on. But in recent years digital high-definition video is becoming widespread.

Deinterlacing

For a long time the only way to shoot video was interlaced.

But for various reasons we would need to work on individual fields instead of the full frames.

And in some cases we want to end up with progressive frames instead of interlaced fields.

High Definition standards

There are many different HD video standards, but most are based on 720 or 1080 vertical resolution.

For instance

1080p24 or 1080i60

720p50



24p

For years video cameras were limited to shooting 50i or 60i.

At some point 'progressive scan' was introduced resulting in 25p or 30p images.

For a long time 24p was considered the 'holy grail' of 'film-look'.

Recently with Video DSLR's (Canon 5D) this whole discussion was revived.

Digital Cinema

Even though there have been experiments in higher framerates in cinema, even the digital standard designed by the DCI (Digital Cinema Initiative) is still mostly focussed on 24 fps.

4K = 4096x2160 24FPS

2K = 2048x1080 at 24 or 48FPS



		
DATE: 06 JULY 12	HÖBBIT	LENS: 50
FPS 48	HH:MM:SS.FF	R: HF L: L
DIR: PETER JACKSON	ROLL # D1630	4400 K
DP: ANDREW LESNIE	SLATE: 305.7 F	TAKE: 1

Flexibility

But with almost all parts of the image pipeline from capture to display being digital today there is an increasing flexibility in supported framerates.

Most current flatscreens have a fixed refresh rate (from 60 to 240 Hz), but will allow a wide range of input formats.





Slow motion

Slow motion has been used for many different purposes.

There typically are several options when you plan for shooting 'slomo':

- Use every original frame twice or more – slowing down the action but resulting in less fluid movement.
- Shoot with a high speed camera: overcranking (film or digital)
- Digitally interpolate the motion.
- Fake slow movement on-set...



Why use slow motion?

On one hand there are practical reasons for using 'slomo'.

Scientific research: to examine certain phenomenon that can not be seen in 'real time'.

Athletic activities of all kinds, to demonstrate skill and style.

To recapture a key moment in an athletic game, typically shown as a replay.

Natural phenomena, such as a drop of water hitting a glass.

Marvels of Motion

<https://www.youtube.com/watch?v=HcWIZjAJ-b8>

Der Heilige Berg

https://www.youtube.com/watch?v=A8mSFJDf_7U

Raging Bull

<https://www.youtube.com/watch?v=fzUTXpvBTVc>

Vsevolod Pudovkin (1893 – 1953)

<http://www.youtube.com/watch?v=k7w4schREas>
(around 9.20)

Bill Viola

<http://www.youtube.com/watch?v=MR9av-l35ME>

John Woo

<https://www.youtube.com/watch?v=3wYCh5nxyCI>

Gangster Trippin

<https://www.youtube.com/watch?v=3k1comdW1Ig>
[w](#)

Alanis Morissette

<https://www.youtube.com/watch?v=OOgpT5rEKIU>

Chariots of Fire

<https://www.youtube.com/watch?v=L-7Vu7cqB20>

In the mood for Love

<https://www.youtube.com/watch?v=EjcTPRkAfL0>

Bullet

<https://www.youtube.com/watch?v=bf2ZJKYaKUc>

HAVOV music video

<http://vimeo.com/58088773>

<http://petapixel.com/2013/02/10/bts-slow-motion-music-video-shot-using-one-continuous-18-second-shot/>

Adam Magyar

<http://westendcameraclub.com/blog/2014/1/11/photographer-adam-magyar>

<http://www.magyaradam.com/>

Faux Slomo

Skateboard

<https://www.youtube.com/watch?v=WIJCo7N4aNk>

Bottle breaking

<https://www.youtube.com/watch?v=IS-MrJnl0aM>

Atomic Man

<https://www.youtube.com/watch?v=RmUzdNLDLml#t=92>



<http://vimeo.com/9078364>

Time-lapse

The first use of time-lapse photography in a feature film was in [Georges Méliès'](#) motion picture *Carrefour De L'Opera* (1897).

Koyaanisqatsi

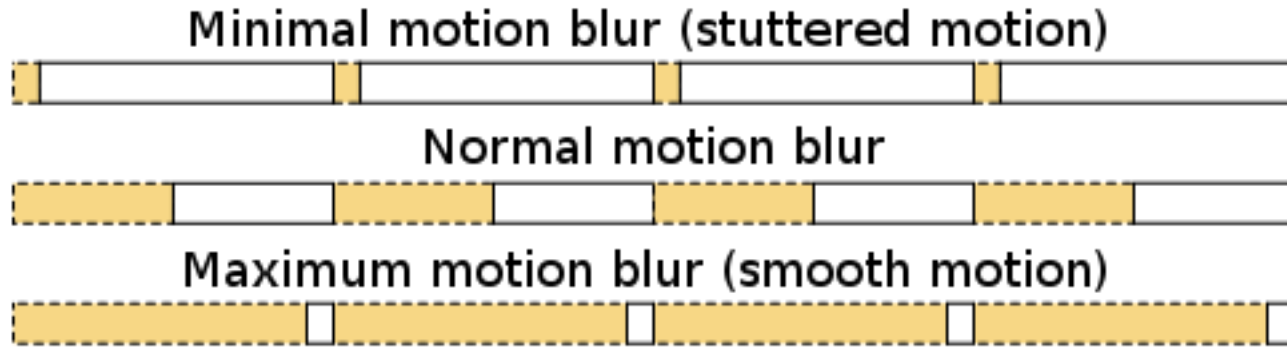
<https://www.youtube.com/watch?v=1jM2WA2WbDc>

Peter Greenaway

New York City

<http://vimeo.com/75320274>

Short vs long exposure time-lapse



DIY motioncontrol rigs

Egg timer pan head

<https://www.youtube.com/watch?v=FwECLh94l10>

<https://www.youtube.com/watch?v=BpMvlu4U3Tk>

<https://www.youtube.com/watch?v=JyVvD8Qzmp8>

<http://artmosh.blogspot.nl/2012/09/how-to-build-diy-motion-control.html>

<http://petapixel.com/2014/04/28/ultra-light-3d->